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IN REPLY REFER TO

Theoretical Division
8719 Colesville Road
Silver Spring, Maryland

November 28, 1960

Dr. Joshua Lederberg
Department of Genetics
Stanford University
Medical Center
Palo Alto, California

Dear Dr. Lederberg:

The experiment of studying the spectroscopy at the impact point seems to me a simple experiment which might yield useful results. Flashes were observed by Wilkins and Moore separately from the impact at Lunik II on the moon; they were obtained with small telescopes (12 and 15 inches) and on the bright face of the moon. A similar study with a larger telescope ought to be profitable, especially since it could be calibrated in a terrestrial laboratory.

I do not think the rocket exhaust would interfere. The energy produced at impact is the kinetic energy of the whole rocket moving at a minimum of 2.4 kilometers/second. This is equivalent to more energy per gram than any except the most energetic fuels. Hence the relative significance of exhaust and vehicle would be roughly in the ratio of their weights.

With reference to the chemical contamination of the surface, I suspect that the action of the sunlight would cleanse the surface rather vigorously of any volatiles deposited on it. Hydrocarbons would evaporate at the moon's temperature ($\approx 100^{\circ}$ C) and would probably be decomposed by the ultraviolet light. Hydrogen would escape at once, and the other substances as soon as vaporized by collision with solar wind atoms.

Contamination of the earth by lunar material has almost certainly occurred frequently in the past as a result of the impact of meteorites on the moon and the knocking off of chunks. Some of these chunks must reach the earth's surface. A chunk could easily descend through the atmosphere like a meteorite with the inside still cold. Eugene Shoemaker points out that the same thing

may well have happened with Martian material. The reverse process is also conceivable though somewhat less probable because of the earth's potential.

There is a point on which it would be most helpful to have biological information; this is on the age of the moon. Since the moon is responsible for most of the action of the tides, and especially for the difference between spring and neap tides, I should think it might be possible to find out minimum values for the age of the moon and for its distance. This issue has become a live one since some recent calculations indicated that the moon might have been captured in post-Cambrian time. If, for instance, the moon was ever at half its present distance, the tides would have been eight times as high. Is it possible to get a line on this from palaeontology? Isn't the ecology of the shoreline a very well-studied subject?

Sincerely yours,

John O'Keefe

John A. O'Keefe
Assistant Chief
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